

# MATERIAL SAFETY DATA SHEET

**SRM Supplier:** National Institute of Standards and Technology  
Standard Reference Materials Program  
Bldg. 202 Rm. 211  
Gaithersburg, Maryland 20899

**SRM Number:** 3164  
**MSDS Number:** 3164  
**SRM Name:** Uranium Spectrometric  
Standard Solution  
**Date of Issue:** February, 1990  
**Date of Revision:** March 1, 1999

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## SECTION I. MATERIAL IDENTIFICATION

**Material Name:** Uranium Spectrometric Standard Solution

**Description:** SRM 3164 is a single element solution prepared gravimetrically to contain a nominal 10 mg/g of uranium with a nitric acid volume fraction of 10 %.

**Other Designations:** Uranium in Nitric Acid (aqua fortis; hydrogen nitrate; azotic acid; engravers acid); Uranyl Nitrate\* (uranium oxynitrate; (T-4)-bis(nitrato-O)dioxouranium; uranium dinitrate dioxide) in Spectrometric Standard Solution

| Name           | Chemical Formulas                                 | CAS Registration Number |
|----------------|---|-------------------------|
| Nitric Acid    | HNO <sub>3</sub>                                  | 7697-37-2               |
| Uranyl Nitrate | (UO <sub>2</sub> )(NO <sub>3</sub> ) <sub>2</sub> | 10102-06-4              |
| Uranium        | U   | 7440-61-1               |

**DOT Classification:** Nitric Acid Solution, UN2031  
Limited Quantity Radioactive Material

**Manufacturer/Supplier:** Available from a number of suppliers

**SRM 3164 is a limited quantity radioactive material that is exempt from radioactive labeling requirements under 49CFR section 173.421. The massic activity of SRM 3164 is less than 500 Bq/g.**

\*The addition of uranium to nitric acid, along with other intermediate chemical reactions, forms uranyl nitrate which will precipitate upon evaporation or drying of the sample.

## SECTION II. HAZARDOUS INGREDIENTS

| Hazardous Components | Nominal Concentration (%) | Exposure Limits and Toxicity Data           |
|----------------------|---------------------------|---|
| Nitric Acid          | 10                        | ACGIH TLV-TWA: 2 ppm or 5 mg/m <sup>3</sup> |
|                      |                           | OSHA TLV-TWA: 2 ppm or 5 mg/m <sup>3</sup>  |
|                      |                           | Human, Oral: LD <sub>50</sub> : 430 mg/kg   |
| Uranyl Nitrate       | 1.7                       | ACGIH TLV-TWA: 0.2 mg/m <sup>3</sup>        |
|                      |                           | OSHA TLV-TWA: 0.05 mg/m <sup>3</sup>        |
| Uranium              | 1                         | ACGIH TLV-TWA: 0.2 mg/m <sup>3</sup>        |
|                      |                           | OSHA TLV-TWA: 0.05 mg/m <sup>3</sup>        |

### SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

| Nitric Acid  | Uranyl Nitrate  | Uranium   |
|--|---|---|
| <b>Appearance and Odor:</b> A white to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; an irritating odor. | <b>Appearance and Odor:</b> Yellow crystals with no odor. | <b>Appearance and Odor:</b> A grayish-white or silvery solid. |
| <b>Relative Molecular Mass:</b> 63.02  | <b>Relative Molecular Mass:</b> 394.02                    | <b>Relative Atomic Mass:</b> 238.02                           |
| <b>Density:</b> 1.0543 (10 % nitric acid)  | <b>Density:</b> 2.807                                     | <b>Density:</b> 19.0  |
| <b>Solubility in Water:</b> Soluble  | <b>Solubility in Water:</b> Slightly soluble              | <b>Solubility in Water:</b> Insoluble                         |
| <b>Solvent Solubility:</b> Decomposes in alcohol.  | <b>Solvent Solubility:</b> Soluble in alcohol and ether.  | <b>Solvent Solubility:</b> Soluble in acetone and acids.      |

**Note:** The physical and chemical data provided is for the pure components. Physical and chemical data on this uranium/nitric acid solution do not exist. The actual behavior of the solution may differ from the individual components. This solution is slightly yellow.

## SECTION IV. FIRE AND EXPLOSION HAZARD DATA

**Flash Point:** N/A

**Method Used:** N/A

**Autoignition Temperature:** N/A

|   |               |     |
|---|---------------|-----|
| <b>Flammability Limits in Air (Volume %):</b> | <b>UPPER:</b> | N/A |
|   | <b>LOWER:</b> | N/A |

**Unusual Fire and Explosion Hazards:** Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Uranyl nitrate is a negligible fire hazard; however, as an oxidizer, it may ignite or explode on contact with combustible materials.

**Extinguishing Media:** Use extinguishing media that is appropriate to the surrounding fire. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen.

**Special Fire Procedures:** Fire-fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece in the pressure-demand or positive-mode and other protective clothing.

## SECTION V. REACTIVITY DATA

**Stability:**            X      Stable                  Unstable

**Conditions to Avoid:** Avoid contact with combustible and other incompatible materials.

**Incompatibility (Materials to Avoid):** Keep nitric acid away from organic materials, plastics, rubber and some forms of coatings. Nitric acid is incompatible with chlorine and metal ferrocyanide. Uranyl nitrate may ignite or explode on contact with combustible materials or organic solvents.

See Section IV: *Unusual Fire and Explosion Hazards*.

**Hazardous Decomposition or Byproducts:** Hazardous decomposition of nitric acid and/or uranyl nitrate can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), as well as nitric acid mist or vapor. Thermal decomposition of uranium may release toxic and/or hazardous gases.

|                                  |                   |          |                       |
|----------------------------------|-------------------|----------|-----------------------|
| <b>Hazardous Polymerization:</b> | <b>Will Occur</b> | <b>X</b> | <b>Will Not Occur</b> |
|----------------------------------|-------------------|----------|-----------------------|

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**SECTION VI. HEALTH HAZARD DATA**

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Route of Entry:   X   Inhalation   X   Skin   X   Ingestion

**Health Hazards (Acute and Chronic): Nitric Acid:** Nitric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

**Uranium and Uranyl Nitrate:** Uranium and uranyl nitrate are nephrotoxins. Since uranyl nitrate is soluble, some inhaled mist may pass into the blood stream and contribute to kidney damage. Chronic inhalation of uranium and/or uranyl nitrate may increase the risk of cancer in the lymphatic and hematopoietic systems and the lungs, possibly associated with the inhalation of radon daughters. Exposure to the materials may cause skin and eye irritation nausea, vomiting, diarrhea, and/or drowsiness.

**Medical Conditions Generally Aggravated by Exposure:** Allergies, skin, respiratory, and eye disorders

**Listed as a Carcinogen/Potential Carcinogen (Nitric Acid):**

|  | Yes           | No           |
|--|---------------|--------------|
| In the National Toxicology Program (NTP) Report on Carcinogens       | <u>      </u> | <u>  X  </u> |
| In the International Agency for Research on Cancer (IARC) Monographs | <u>      </u> | <u>  X  </u> |
| By the Occupational Safety and Health Administration (OSHA)          | <u>      </u> | <u>  X  </u> |

**Listed as a Carcinogen/Potential Carcinogen (Uranium and Uranyl Nitrate):**

|  | Yes           | No            |
|--|---------------|---------------|
| In the National Toxicology Program (NTP) Report on Carcinogens       | <u>      </u> | <u>  X  </u>  |
| In the International Agency for Research on Cancer (IARC) Monographs | <u>      </u> | <u>  X  </u>  |
| By the Occupational Safety and Health Administration (OSHA)          | <u>  X  </u>  | <u>      </u> |

**EMERGENCY AND FIRST AID PROCEDURES:**

**Skin Contact:** Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Obtain medical assistance if necessary.

**Eye Contact:** Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Obtain medical assistance.

**Inhalation:** If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Obtain medical assistance if necessary.

**Ingestion:** If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance if immediately.

**Note to Physician (Nitric Acid):** Wash affected skin areas with 5 % solution of sodium bicarbonate (NaHCO<sub>3</sub>). If ingested, the risk versus the benefit of the passage of a naso-gastric tube is debatable. Activated charcoal is of no value. DO NOT give the exposed person bicarbonate to neutralize the material.

**TARGET ORGAN(S) OF ATTACK:** **Nitric Acid:** The skin, teeth, eyes, and upper respiratory tract  
**Uranyl Nitrate and Uranium:** The kidneys

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## SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

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**Steps to be Taken in Case Material is Released or Spilled:** Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation or destruction.

**Waste Disposal:** Follow all federal, state, and local laws governing disposal.

**Handling and Storage:** Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear gloves and chemical safety glasses where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas several times a day with soap and warm water. The sample container should be handled by persons qualified to handle both radioactive material and strong acid solutions.

**Note:** Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

Store this material at room temperature.

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## SECTION VIII. SOURCE DATA/OTHER COMMENTS

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**Sources:** MDL Information Systems, Inc., MSDS *Uranium*, September 10, 1998.  
MDL Information Systems, Inc., MSDS *Uranyl Nitrate*, December 8, 1998.  
MDL Information Systems, Inc., MSDS *Nitric Acid*, March 13, 1995.  
The Merck Index, 11<sup>th</sup> ed., 1989.  
The Sigma Aldrich Library of Chemical Data, Ed. II, 1988.

**Disclaimer:** Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified values for this material are given on the NIST Certificate of Analysis.